The American Fertilizer

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Greensboro, N. C.
Havana, Cuba
Henderson, N. C.
Montgomery, Ala.
Norfolk, Va.
No. Weymouth, Mass.
Pensacola, Fla.
Pierce, Fla.
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Henderson, N. C.
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Laurel, Miss.
Montgomery, Ala.
Montreal, Quebec, Can.
New York, N. Y.
Norfolk, Va.
No. Weymouth, Mass.
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MENTION "THE AMERICAN FERTILIZER" WHEN WRITING TO ADVERTISERS.

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AMERICAN FERTILIZER

"That man is a benefactor to his race who makes two blades of grass to grow where but one grew before."

Vol. 97 SEPTEMBER 12, 1942 No. 6

An Easier, More Effective Method of Applying Fertilizers*

Plowing Under Fertilizers, Like Plowing Under Manure, Appears to Have Distinct Advantages, Particularly in Saving Labor—Attachments Described.

By CHARLES B. SAYRE

ANY method that will reduce the labor required in any farm operation and yet perform that operation more effectively is of timely interest to farmers seeking to increase the production of food for freedom. Consequently, an easier and more effective method of applying fertilizers should be of particular interest at this time. To obtain profitable yields of vegetable crops, it is necessary to apply fertilizers to most soils in New York State. The yields and the net returns are affected as much by the method of applying the fertilizers as by the kind and amount of fertilizer used.

Recently, methods of applying fertilizers have undergone profound changes and some new devices have been introduced that considerably reduce the labor involved. One of these recent improvements is an attachment to the plow by means of which the fertilizer can be applied at the same time the plowing is done. (See Fig. 1 to 4.) This saves considerable time in applying the fertilizer, and at the same time places the fertilizer where it can be used more effectively by the crops. Although growers have plowed under manure for years and know from experience that it is a good practice, there are many who hesitate to plow under chemical fertilizers because they fear that the fertilizer will be lost by leaching. That this fear is unfounded is shown by results obtained at Geneva (Table 1) and at many other experiment stations and by commercial growers who have been plowing under fertilizers in comparison with various other methods of application.

*Reprinted from "Farm Research," July, 1942, publication of the New York Agricultural Experiment Station, Geneva, N. Y.

What Others Report

On the Seabrook Farms at Bridgeton, N.J., the largest vegetable farm in the United States, they tried out the plowing under of fertilizers two years ago. Their soil is very sandy, but the crops responded so favorably to the plowed under fertilizer that they now plow under the fertilizers for all of their crops, even for such quick-growing crops as spinach and peas. Spinach is generally harvested about 45 days after planting and peas in about 60 days, yet bigger yields were obtained where the fertilizer was plowed under, showing that the tap roots reached the fertilizer quickly.

In a test with soybeans in Indiana where the fertilizer was broadcast and disced into the surface soil, the yield was 17.6 bushels per acre. Where the same amount of fertilizer was broadcast and plowed under, the yield was 23.4 bushels.

In Maryland many large growers are plowing under fertilizer for peas and in Ohio increased yields of sugar beets and of canning beets were obtained where the fertilizer was plowed under.

Another advantage of plowing under fertilizer is that there is no danger of "burning" the crop or injuring the germination of seeds. It is a safe method of applying fertilizers, it saves labor, and it is more effective because it places the fertilizers in moist soil where they are more accessible to the roots, especially during drought periods and where there is less rapid fixation.

Undoubtedly a quick start in the growth of the crop is very important in producing large yields. Detailed studies show that there is no delay in growth nor in earliness of maturity where fertilizer is plowed under. A study of root growth reveals the reason for this. With all vegetable crops the tap root develops rapidly and penetrates downward at the rate of about 1 inch or more per day, at least until the plow depth has been reached. In friable soils the roots continue downward much deeper. In the early growth of seedlings the downward penetration of roots is more rapid than the upward growth of the above-ground parts. Consequently, the tap roots reach the plowed under fertilizer very quickly and there is no delay in growth of crops fertilized in this manner.

How It Is Done

There are two methods of plowing under fertilizers. In one case the fertilizer can be put on in advance with a lime sower or fertilizer drill or by hand broadcast and then plowed under. In this case the fertilizer is distributed from the top to the bottom of the furrow, most of it falling to the bottom as the furrow turns over, but much of it being spread on the adjacent furrow from top to bottom. In the second method the fertilizer is applied with an attachment to the plow and may either be deposited in a band in the bottom of the furrow or may be deposited ahead of the plow, similar to the method previously described. One year's test at Geneva (Table 1) indicates that applying the fertilizer in a band in the bottom of the furrow is more effective. Similar results have been reported from other experiment stations on a great variety of soils.

In 1940, a year of exceptionally heavy rainfall in May and June, there was no significant difference between the yields obtained by drilling the fertilizer deeply in the final preparation of the land (treatment No. 1, Table 1) as compared with the same amount of fertilizer broadcast and plowed under 3 weeks earlier when the cover crop was turned under. With the heavy rains one would expect shallow rooting and might expect some loss of the deeply placed fertilizer from leaching. Yet the deeply placed fertilizer, both the plowed under treatment (No. 2) and the deeply drilled treatment (No. 1) produced over 1½ tons more tomatoes than the same amount of fertilizer disced and harrowed in the surface soil (treatment No. 3).

In 1941, when there was a very severe drought during May and June and very light rainfall throughout the season, a new treatment was introduced, namely, the fertilizer

Fig. 1—A fertilizer attachment for 2-bottom plow assembled by a New Jersey farmer from parts of a potato planter. Used successfully for 3 years.

was applied in a band in the bottom of each furrow (treatment No. 4, Table 1). This placed all the fertilizer 9 inches below the surface. This method increased the yield 2¼ tons above any other method of applying the fertilizer, yet it was the easiest method of applying fertilizer, simply requiring that the fertilizer hopper be kept full while plowing. Furthermore, the fertilizing was completed early in the season before the rush of planting began.

The advantage of applying fertilizer with an attachment to the plow is that no extra

TABLE 1.—EFFECT OF PLOWING UNDER FERTILIZERS FOR TOMATOES AT GENEVA, N. Y.

Treatment No.	Fertilizer and Method of Application	Yield in Tons per Acre	
		To Aug. 31	Total
	Tomatoes Transplanted May 24, 1940 (10.18 in. rain in May and June)		
1	600 lbs. 5–20–5 drilled in 4 in. deep May 23, not disturbed.......	2.64	15.48
2	600 lbs. 5–20–5 broadcast and plowed under May 10.............	2.33	15.49
3	600 lbs. 5–20–5 broadcast, disced and harrowed in May 23........	2.11	13.88
	Tomatoes Transplanted May 23, 1941 (4.84 in. rain in May and June)		
4	600 lbs. 10–20–10 plowed under May 6 in bottom of furrow (9 in. deep)..	0.91	20.76
5	600 lbs. 10–20–10 drilled in 4 in. deep May 22, not disturbed......	0.71	18.50
6	600 lbs. 10–20–10 broadcast and plowed under May 6............	0.44	18.42

labor is involved in the operation, except the labor of keeping the hopper filled. In most cases this means that the fertilizer will be applied a few weeks before the crop is planted, but this seems to make no difference. Tests have been made at Geneva in which the fertilizer was plowed under with a cover crop 3 weeks before tomato plants have been set and even 6 weeks before cabbage plants have been set, and yet this plowed under fertilizer produced larger yields than the same amount of fertilizer applied by other methods.

There are several reasons why fertilizer is particularly effective when applied in a band in the bottom of the furrow. In the first place it is applied deep enough so that it will be in the zone of active root growth. During dry seasons particularly this makes a tremendous difference in the growth of the crop. In very dry periods which commonly occur during August, the roots grow downward seeking more moist soil; consequently, the deeply applied fertilizer which will be in moist soil is more readily available to the crop. Under drought conditions fertilizer that has been applied close to the surface is not readily accessible to the crop. Roots cannot thrive in dry soil, consequently fertilizer that has been applied close to the surface will be in too dry a zone for roots to flourish. Furthermore, the movement of the soil moisture and with it the dissolved fertilizers will be upward toward the surface in the capillary rise of water. Therefore, while the roots are going downward for moisture, the shallowly applied fertilizers will be moving closer to the surface and the plants may be starving when abundant fertilizer is out of their reach because it has been applied too close to the surface.

Fig. 2—Fertilizer attachment for plow designed by implement manufacturer. It can be attached to plow in 15 minutes.

What Happens to Fertilizers

To explain the effectiveness of fertilizer that has been plowed under, it might be well to consider first what happens to fertilizer when it is applied to the soil. This will involve a consideration of the different types of fertilizers. Three general types of nitrogen fertilizer are used, namely, the nitrate form such as nitrate of soda, nitrate of potash,

(Continued on page 22)

WPB Issues List Of Approved Fertilizer Grades

ON SEPTEMBER 12th, the War Production Board issued Part 3080 of Conservation Order No. M-231, establishing a list of approved grades for mixed fertilizers in 33 of the principal fertilizer-using States. The Rocky Mountain and Pacific Coast States are not included in the order.

The order forbids fertilizer manufacturers, dealers and agents from selling, and any person from using on crops, any fertilizer except such as are included in the approved grades for that particular State. Exception is made for deliveries of fertilizers now on hand. The order is not to be construed as permitting the use of any grade of chemical fertilizer in any State where the laws of that State specifically prohibit it.

Fertilizers to be used on grain sown in the fall of 1942 shall not contain any chemical nitrogen, and the same restriction applies to fertilizers used on lawns, golf courses, non-commercial flowers and shrubbery.

Fertilizers containing chemical nitrogen must be shipped in packages of not less than 100 lb. except that stocks of 80-lb. bags now on hand may be used up.

Shipments of fertilizers for use in 1943 cannot be made by any manufacturer prior to November 15, 1942.

When using organic nitrogen in a fertilizer mixture, the nitrogen content in the mixture must be at least 3 per cent and the total plant food content (N-P-K) must be at least 14 per cent.

The effective date of the order is September 12, 1942.

In addition to the grades listed below, the folllwing materials may be sold in each State included in the list: Nitrate of soda (16% N); nitrate of soda-potash (14–0–14); sulphate of ammonia (20% N or higher); cyanamid (20% N or higher); ammonium phosphate (11–48–0 or 16–20–0); superphosphate (18% P_2O_5 or higher); muriate of potash (50% K_2O or higher); sulphate of potash (48% K_2O or higher); manure salts (22% K_2O or higher); sulphate of potash-magnesia (18% K_2O or higher); any grade of basic slag, ground phosphate rock, colloidal phosphate, cotton hull ash, wood ash.

NEW ENGLAND STATES

Maine

0—14—14	4— 8—12	5—20—10
0—20—20	4—10—10	6— 9—15
3—12— 6	4—16—20	6—12—18
3—12—15	4—12— 4	6—15—15

New Hampshire

0— 9—27	3—12—15	5— 3— 5*
0—14—14	4—10—10	5—20—10
0—20—20	4—12— 4	6— 3— 6*
3—12— 6	4—16—20	6—15—15

Vermont

0—14—14	4—10—10	5—20—10
0—20—20	4—16—20	6— 3— 6*
3—12— 6	4—12— 4	6—15—15
3—12—15	5— 3— 5*	

Massachusetts

0— 9—27	3—12—15	5— 3— 5*
0—14—14	4—10—10	5—20—10
0—20—20	4—12— 4	6— 3— 6*
3—12— 6	4—16—20	6—15—15

Rhode Island

0—14—14	3—12—15	5—20—10
0—20—20	4—10—10	6—15—15
3—12— 6	4—12— 4	
	4—16—20	

Connecticut

0— 9—27	3—12—15	5— 3— 5*
0—14—14	4—10—10	5—20—10
0—20—20	4—12— 4	6— 3— 6*
3—12— 6	4—16—20	6—15—15

*For tobacco.

MIDDLE ATLANTIC STATES

New York

0—12—12	0—24—12	4—10— 5
0—14— 7	3—12— 6	4—10—10
0—14—14	3—12—15	4—12— 4
0—16— 8	4— 8—12	4—16— 4
0—20—20		4—16— 8

New Jersey

0—12—12	0—24—12	3—18— 9
0—14— 7	2— 8—10	4— 8—12
0—14—14	2—12— 6	4—10—10
0—16— 8	3—12— 6	4—12— 4
0—20—20	3—12—15	4—12— 8
		4—16— 8

Pennsylvania

0—12—12	3—12— 6	4—12—12
0—14— 7	3—12—15	4—16— 4
0—14—14	3—18— 9	4—16— 8
0—16— 8	4— 8—12	4—16—20
0—20—20	4— 8—16	4—24—12
0—24—12	4—10— 5	7—21— 7
2— 8—10	4—10—10	10— 6— 4
2—12— 6	4—12— 4	

Delaware

0—12—12	2—12—12	4—16— 8
0—14— 7	3— 9—15	4—16—20
0—14—14	3—12— 6	4—24—12
0—16— 8	3—12—15	5—10— 5
0—20—20	3—18— 9	7—21— 7
0—24—12	4— 8—12	10— 0—10
2— 8—10	4—12— 4	10— 6— 4
2—12— 6	4—12— 8	

Maryland

0—12—12	2—12—12	4—16— 4
0—14— 7	3— 9—15	4—16— 8
0—14—14	3—12— 6	4—16—20
0—16— 8	3—12—15	4—24—12
0—20—20	3—18— 9	5—10— 5
0—24—12	4— 8—12	7—21— 7
2— 8—10	4—12— 4	10— 0—10
2—12— 6	4—12— 8	10— 6— 4

6— 6— 8 (for tobacco plant beds only)

West Virginia

0—14— 7	2—12— 6	4—12— 4
0—16— 8	3—18— 9	4—12— 8
0—24—12		10— 6— 4

Virginia

0—12—12	2—12—12	4— 8—12
0—14— 7	3— 8— 5	4—12— 4
0—14—14	3— 9— 6	4—12— 8
0—16— 8	3— 9—15	4—16— 4
0—20—20	3—12— 6	4—16— 8
0—24—12	3—12—15	5—10— 5
2— 8—10	3—18— 9	10— 0—10
2—12— 6	4— 8— 4	10— 6— 4
	4— 8— 6	

4— 9— 3 (for tobacco plant beds only)

SOUTHEASTERN STATES

North Carolina

(basic) 0—10—10	3— 9— 6	4— 9— 3*
0—14— 7	3— 9— 9	4—10— 6
(basic) 2— 8—10	3—12— 6	4—12— 4
2—10— 6	4— 8— 4	4—12— 8
2—12— 6	4— 8— 6	5— 5—20
3— 8— 5	4— 8— 8	10— 0—10

South Carolina

0—12—12	3— 9— 6	4— 8— 8
0—14— 7	3— 9— 9	4— 9— 3
2—12— 6	3—12— 6	4—12— 4
3— 8— 5	4— 8— 4	4—12— 8
	4— 8— 6	

Georgia

0—14—10	3— 9— 9	4— 8— 8
2—12— 6	3—12— 6	4— 9— 3
3— 8— 5	4— 8— 4	4—12— 4
3— 9— 6	4— 8— 6	10— 0—10
4— 2—10**		

Florida

0— 8—12	3— 8— 5	4—12— 4
0— 8—24	3— 8— 8	4—12— 6
0—10—10	4— 4— 8	5— 5— 8
0—12—16	4— 5— 7	5— 6—10
0—14— 5	4— 6— 8	5— 7— 5
0—14—10	4— 7— 5	5— 8— 8
(+Mn) 0—16— 0	4— 8— 4	6— 4— 8
2— 8— 6	4— 8— 6	6— 6— 6
2— 8—10	4— 8— 8	8— 0— 8
2—10— 4	4— 9— 3	8— 0—12
3— 6—10	4—10— 7	12— 0—10

*For tobacco plant beds only.
**For shade tobacco.

Alabama

0—14—10	4—10— 4	4—10— 7
4—12— 4		

Mississippi

0—14— 7	4— 8— 4	4— 8— 8

Tennessee

0—12—12	2—12— 6	4—10— 4
0—14— 7	3— 9— 6	4—12— 4
2— 8—10	4— 8— 8	5—10— 5 (Vegetables only)

WEST SOUTH-CENTRAL STATES

Louisiana

0—14—14	3—12—12	4—10— 7
0—14— 7	3—15— 0	4—12— 4
3—12— 6	4— 8—12	9— 9— 0
3—12— 9		

Texas

0—14— 7	4— 8—12	10—10— 0
3—12— 6	4—10— 7	10—20— 0
3—15— 0	4—12— 4	

Arkansas

0—20—20	3—12— 6	4—10— 7
0—14— 7	3—12—12	4—12— 4
3— 9—18	4— 8—12	

Oklahoma

0—14— 7	3—12— 9	4—12—4
3—12— 6	4—10— 7	

NORTH CENTRAL STATES

Kentucky

0—12—12	2—12— 6	4— 8— 8
0—14— 7	3— 9— 6	4—10— 6
0—14—14	3— 9—18	4—12— 4
0—16— 8	3—12— 3	4—12— 8
0—20—10	3—12—12	4—16— 4
0—20—20	3—18— 9	5—10—10

Ohio

0— 9—27	0—16— 8	4— 8— 8
0—10—20	0—20—10	4—10— 6
0—12—12	0—20—20	4—12— 4
0—12—24	2—12— 6	4—16— 4
0—12—36	3— 9—18	4—24—12
0—14— 7	3—12—12	5—10—10
0—14—14	3—18— 9	10— 6— 4

Indiana

0— 9—27	0—14—14	2—16— 8
0—10—20	0—16— 8	3— 9—18
0—12—12	0—20—10	3—12—12
0—12—24	0—20—20	3—18— 9
0—12—36	2— 8—16	4—10— 6
0—14— 7	2—12— 6	4—12— 4
		4—24—12
		10— 6— 4

Illinois

0— 9—27	0—16— 8	3— 9—18
0—12—12	0—20—10	3—12—12
0—12—36	0—20—20	3—18— 9
0—14— 7	2—12— 6	4—10— 6
0—14—14	2—16— 8	4—12— 4
		4—24—12
		10— 6— 4

(Continued on page 18)

The American Chemical Society

Abstracts of some of the Papers presented at the Meeting of the Division of Fertilizer Chemistry at Buffalo, N. Y., September 7 to 11, 1942, H. B. Siems presiding.

Chemical Properties of Various Commercial Superphosphates Before and After Ammoniation

E. W. Harvey, The Barrett Division, Allied Chemical & Dye Corp., New York, N. Y., and L. V. Rohner, The Solvay Process Co., Syracuse, N. Y.

The chemical changes involved in the "reversion" of available P_2O_5 of ammoniated superphosphates are not clearly defined and divergent view exist as to the probable relative importance of the likely reactions.

Ammoniation studies have been made by the authors with eight commercial superphosphates obtained from as many different sources, to determine whether or not there could be found an association between any constituent and P_2O_5 reversion under varying conditions such as rates of ammoniation, temperatures, and durations of storage.

This paper presents briefly the data obtained from the laboratory studies of these ammoniated superphosphates and discusses the possible relationships of the fluorine, iron, and aluminum contents to the rates and extent of reversion of the P_2O_5.

Factors Affecting the Availability of Ammoniated Superphosphates

John O. Hardesty, J. Richard Adams, and William H. Ross, Division of Soil and Fertilizer Investigations, Bureau of Plant Industry, Washington, D. C.

The capacity of the United States for producing free ammonia is now being greatly increased and it is probable that the cost of production following the war will be less than it is at present. It therefore becomes of economic importance to know the conditions under which the maximum quantity of free ammonia can be used in a fertilizer mixture without causing any appreciable loss in the efficiency of the fertilizer in promoting crop growth. A further study was accordingly undertaken of the chemical availability and of the efficiency of ammoniated superphosphate mixtures to plants as affected (1) by the degree of ammoniation of the mixture; (2) the storage temperature of the mixture following ammoniation; (3) the moisture content of the mixture during ammoniation and storage; (4) the sources of the superphosphates used in the preparation of the ammoniated superphosphates mixtures: (5) the presence of dolomite in the mixture during ammoniation and storage; and (6) the presence of fluorides in the mixture during ammoniation and storage.

The present report is limited to the factors that affect the chemical availability of ammoniated superphosphate mixtures. The results obtained show that:

(1) Dolomite-containing mixtures that had been ammoniated up to a maximum of 5 per cent on the basis of the superphosphate present, or 60 pounds of NH_3 per ton, showed little or no increase in citrate-insoluble P_2O_5 when stored at 20° C. (68° F.) for 36 days.

(2) A significant increase in citrate-insoluble P_2O_5 occurred when the same mixtures were stored at 60° C. (140° F.) and still more when the storage temperature was increased to 90° C. (194° F.). No appreciable reversion occurred under the same conditions in the absence of dolomite.

(3) Ammoniated mixtures prepared from superphosphates from different sources differ in the extent to which they undergo reversion when stored at temperatures above normal.

(4) Superphosphate mixtures initially containing about 1 per cent or less of free moisture will not absorb ammonia unless heated to a temperature of about 45° C. (113° F.). Mixtures of this kind did not show any increase in citrate-insoluble P_2O_5 when ammoniated at the rate of 60 pounds of NH_3 per ton and stored at 90° C. (194° F.) for 36 days, although the free moisture under these conditions was increased to about 3 per cent by ammoniation.

(5) Synthetic 4–12–4 mixtures that contained monocalcium phosphate, dolomite and sodium fluoride but no calcium sulphate showed no citrate-insoluble P_2O_5 when ammoniated at the rate of 60 pounds of NH_3 per ton of mixture and stored at ordinary temperatures for 36 days. Mixtures prepared in the same way, except that they contained calcium sulphate as well as dolomite, showed a marked increase in citrate-insoluble P_2O_5 when stored under the same conditions.

Effect of Mixed Fertilizers and Fertilizer Materials on the Concentration of the Soil Solution

L. F. Rader, Jr., L. M. White, and Colin W. Whittaker, Bureau of Plant Industry, Division of Soil and Fertilizer Investigations

Methods of applying fertilizers such as band or hill placement, that localize the fertilizer in a small zone in the soil, introduce a different set of conditions from those met in broadcast application. Perhaps the most

important of these conditions is the effect on the concentration of the soil solution on which the plant feeds. In band placement the fertilizer is in contact with a relatively small amount of soil, so that the soil solution in the band or near it may contain large quantities of soluble salts. If the seeds are too near this zone of high concentration they may not germinate or if germination takes place the plants may be injured later by the roots coming into contact with this zone. It is important, therefore, that the action of fertilizers in increasing the concentration of the soil solution be thoroughly understood.

The present paper presents the results of a study of the effect of various fertilizer materials and mixed fertilizers on the osmotic pressure of the soil solution and shows how these results can be used to calculate the effect of other mixed fertilizers if their formulas are known. Data are presented on the effect of most of the common fertilizer ingredients on the osmotic pressure of the soil solution and the results obtained with actual mixed fertilizers are compared with calculated values. Most of the data were obtained on the Norfolk sandy loam and Cecil clay loam soils, but some of the more important materials and mixed fertilizers were studied on five other important soil types.

The Relationship Between the Salt Index of a Fertilizer and Its Most Efficient Placement in the Soil

Wm. H. Ross, J. Richard Adams, and L. F. Rader, Jr., Division of Soil and Fertilizer Investigations, Bureau of Plant Industry, Washington, D. C.

Soluble fertilizer salts differ not only in their content of plant food but also in their effect on the concentration of the soil solution. Different fertilizer salts may therefore differ greatly in their influence on the soil solution when added to the soil in quantities to give equal applications of plant food.

Thus, a unit of nitrogen as sodium nitrate has about 8 times the effect on the concentration of the soil solution as a like quantity of nitrogen in the form of ammonia, and a similar relationship holds true when potash is applied as 20 per cent manure salts and as potassium sulphate. It has long been known that the salt effect of fertilizers is one of the factors to be considered in connection with their proper placement in the soil, but little attention seems to have been given to the differences in the salt effects of the various fertilizers that have been used in the numerous experiments that have been made on fertilizer placement in different parts of the country during the past twelve years.

Inasmuch as present-day mixtures have a lower average salt index than those formerly used, a comparison was made of the fertilizer efficiency of a 4–8–4 mixture having a very low salt index with one of the same grade having a salt index of about four times as great. Millet was grown as the test crop on a soil of low fertility. The low salt index fertilizer gave higher yields when placed in bands one-half inch from the seed than when placed two inches from the seed. It also gave much higher yields at one-half inch from the seed than was given by the high salt index fertilizer placed at two inches from the seed. Injury to the seed and loss of stand resulted when the high index fertilizer applied at the rates used in these tests was placed at a distance of one-half inch from the seed. It is recognized that different results might have been obtained if the tests had been made with a more tolerant crop on a soil of a higher fertility level.

The War-Time Contribution of the American Potash Industry

J. W. Turrentine, American Potash Institute

An analysis of the current situation respecting rates of production of and prospective demands for potassium compounds indicates the entire adequacy of supplies for North American requirements. This conclusion is based on the suppositions that production will continue without interruption, that deliveries will not be restricted by transportation inadequacies, and that distribution will be based equitably on the current needs of buyers and of the consumers whom they serve. The true significance of this situation can only be appreciated by contrasting it with that of World War I when with the abrupt cessation of imports in 1914 supplies of these essential commodities soon disappeared from the American market. In 1939 the results of foresight, research, and industrial development covering thirty years reached their culmination when the American potash industry shifted both its viewpoint and its operations from a peace-time to a war-time basis and promptly assumed the task of meeting Continental needs. Production capacity was expanded, products were diversified, and deliveries were directed where most needed.

Now in World War II the Nation can proceed with its greatly enlarged agricultural and chemical programs entirely without apprehension that potash supply might become a limiting factor. These programs call for

(Continued on page 20)

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Principal Articles in This Issue

Superphosphate Production Still Increasing

Cooperating in the program for a record production of foodstuffs, superphosphate producers are maintaining production at a high level. Output in the last few months has risen slightly instead of showing the seasonal decline which usually occurs in the summer months.

July production was larger than in any other July for which data are available. Total output was 23 per cent larger than in July 1941. Most of the increase was due to larger production at plants in the northern area.

Superphosphate Production, Shipments, and Stocks for July and January-July, 1942 and 1941

Expressed throughout in equivalent tons of 16% A. P. A. Based on reports by acidulators to the National Fertilizer Association.†

June	United States 1942 1941–42	1941 1940–41
Stocks—First of month:		
Bulk superphosphate	808,966	678,991
Base and mixed goods	157,094	258,878
Production:		
Bulk superphosphate	379,027	312,303
Base and mixed goods	12,119	5,409
Total Production	391,146	317,712
Other Receipts*	43,225	48,044
Book Adjustments	−9,197	+6,834
Total Supply	1,391,234	1,310,459
Shipments:		
Superphosphate:		
To mixers	79,018	85,428
To other acidulators	38,531	38,968
To consumers, etc	62,349	31,237
Total Superphosphate	179,898	155,633
Base and mixed goods	16,626	17,367
Total Shipments	196,424	173,000
Stocks—End of month:		
Bulk superphosphate	953,372	773,601
Base and mixed goods	241,438	333,858
Total Stocks	1,194,810	1,137,459
Accumulated Production and Shipments for January-July		
Production:		
Bulk superphosphate	2,723,180	2,259,904
Base and mixed goods	80,174	73,652
Total Production	2,803,354	2,333,556
Shipments:		
Superphosphate:		
To mixers	1,041,335	965,711
To other acidulators	350,728	424,475
To consumers, etc	836,248	771,821
Total Superphosphate	2,228,311	2,162,007
Base and mixed goods	1,281,501	1,132,999
Total Shipments	3,509,812	3,295,006

*Includes inter-company transfers.
Base includes wet and/or dry base.
†Represents approximately 85% of total production.

If the trend in the January-July period continues through the remainder of the year, aggregate United States production of superphosphate in 1942 will exceed 1941 by about a million tons (basis 16 per cent A. P. A.).

Shipments continue to run above last year, but the rise is not as great as in production. In consequence, stocks have been increasing.

Stocks of bulk superphosphate at the end of July were comparatively large for the season. Stocks on July 31st had not been as large in many years as they were this year. The greater part of the accumulation of stocks has been in the northern area, where production has shown a pronounced rise.

Stocks of superphosphate in base and mixed goods are at a relatively low level, considerably below last year.

Potash Production Still Increasing

Figures released by the American Potash Institute show that the production of potash salts in this country continues to increase. During the fertilizer year from June, 1941, to May, 1942, inclusive, deliveries of American-made potash salts totalled 597,090 tons of K_2O content. As the K_2O tonnage for the calendar year 1941 was 512,278, this indicates an increase of almost 85,000 tons during the first five months of the present year over the shipments of the same period for 1941.

Of the total tonnage, only 65,017 tons went into chemical and other lines of manufacture, leaving the balance of 532,073 tons for agricultural uses.

As in past years the bulk of this production consisted of muriate of potash, but a noteworthy feature was the increase in production of sulphate of potash, which this year amounted to 44,141 tons K_2O. This compares with 34,000 tons of sulphate during the calendar year 1941 and 21,000 tons during 1940.

July Sulphate of Ammonia

July figures for by-product sulphate of ammonia continued at the established production levels. Shipments, however, decreased 63 per cent from the June totals, with the result that stocks on hand at the end of the month showed a marked increase.

	Sulphate of Ammonia Tons	Ammonia Liquor Tons NH_3
Production		
July, 1942	64,288	2,792
June, 1942	63,888	2,720
July, 1941	62,570	2,713
January-July, 1942	448,178	19,543
January-July, 1941	430,833	18,285
Shipments:		
July, 1942	21,330	2,988
June, 1942	57,788	2,593
July, 1941	54,878	2,865
Stocks on Hand:		
July 31, 1942	62,654	711
June 30, 1942	19,760	761
July 31, 1941	45,218	768
June 30, 1941	37,565	810

Deliveries of Potash Salts of American Origin for the Period June-May 1941-42

In tons of 2,000 lbs. K_2O

Institute Territories (Agr.)	Muriate 60 Per cent	Muriate 50 Per cent	Manure Salts	Sulphate	Total
South*	179,711.24	27,235.55	31,709.05	24,510.17	263,166.01
Northeast	97,034.66	3,417.41	1,207.55	5,894.67	107,554.29
Midwest	82,984.06	3,405.90	7,186.68	1,139.38	94,716.02
West	5,645.96	207.00		6,379.15	12,232.11
Total U. S.	365,375.92	34,265.86	40,103.28	37,923.37	477,668.43
Canada	19,910.08	1,102.08	4,273.19	2,222.97	27,508.32
Cuba	3,198.37		122.46	386.59	3,707.42
Pureto Rico	10,388.87			1,619.98	12,008.85
Hawaii	9,581.00			1,599.00	11,180.00
Total Inst. Territories	408,454.24	35,367.94	44,498.93	43,751.91	532,073.02
Total Chemical**	64,627.00			390.00	65,017.00
Total Chem. and Agr.	473,081.24	35,367.94	44,498.93	44,141.91	597,090.02

*South—Ala., Ark., Fla., Ga., La., Miss., N. C., Okla., S. C., Tenn., Texas, Va., W. Va.
Midwest—Ill., Ind., Ia., Kans., Ky., Mich., Minn., Mo., N. Dak., Ohio, Wisc.
Northeast—Conn., Del., Me., Md., D. C., Mass., N. J., N. Y., Pa., R. I., Vt.
West—Calif., Colo., Idaho, Mont., N. Mex., Ore., Utah, Wash.
**Includes 487 tons K_2O delivered to Canada.

August Tag Sales

Fertilizer sales in August in 17 states, as indicated by the sale of tax tags, totaled 212,000 tons, compared with 180,000 tons a year earlier and 162,000 tons two years earlier.

Sales in the South were moderately smaller than in August, 1941, but were larger than in August, 1940. August sales in the southern region are seasonally low and year-to-year fluctuations are of little value in indicating trend.

The midwestern group of States, in the aggregate, experienced an increase of one-third over last year, with increases in three States much more than offsetting declines in the other two. August sales are quite important in the Midwest, due to the heavy demand for fertilizer for fall wheat.

January-August sales in the South were slightly below the corresponding month of last year, but were well above the 1940 level. In the Midwest, however, the eight-month total was considerably above last year.

Cushman Resigns From OPA

George Cushman, chief of the Fertilizers and Insecticides Branch, Office of Price Administration, tendered his resignation as of September 1st and has returned to his former position of operating head of Long Island Produce & Fertilizer Co., of Riverhead, N. Y. Since March 1st Mr. Cushman has given valuable service to the Government, first as consultant and later as chief of the Branch, and it is regretted that his personal affairs make it necessary for him to give up this important work. Pending selection of a successor, Cedric Gran has been appointed acting chief of the Branch.

FERTILIZER TAX TAG SALES

	August				January-August			
	1942		1941	1940	1942		1941	1940
State	% '41	Tons	Tons	Tons	% '41	Tons	Tons	Tons
Virginia	147	17,350	11,832	18,445	107	340,218	318,078	313,821
N. Carolina	268	10,304	3,850	4,220	105	1,046,587	995,651	975,825
S. Carolina	75	4,010	5,340	1,920	91	611,294	672,547	638,574
Georgia	159	3,570	2,242	1,890	98	731,950	746,121	714,663
Florida	41	14,280	34,998	27,777	103	411,258	400,851	334,661
Alabama	433	1,300	300	1,950	99	555,750	563,200	562,050
Mississippi	108	6,000	5,550	700	89	287,067	321,942	293,295
Tennessee	132	6,225	4,725	2,225	118	150,180	126,975	123,873
Arkansas	540	1,350	250	300	115	129,308	112,750	93,750
Louisiana	27	400	1,500	850	91	135,436	148,910	133,531
Texas	124	815	655	400	93	110,118	118,131	103,581
Oklahoma	107	450	420	105	79	7,761	9,800	5,853
Total South	92	66,054	71,662	60,782	100	4,516,927	4,534,956	4,293,477
Indiana	182	102,212	56,072	55,700	117	350,933	299,598	253,944
Illinois	173	9,393	5,445	4,462	137	71,778	52,446	40,660
Kentucky	118	7,735	6,566	7,489	121	126,827	104,877	104,189
Missouri	78	25,389	32,429	29,315	88	62,249	70,500	55,580
Kansas	18	1,455	8,263	3,885	56	7,760	13,861	8,683
Total Midwest	134	146,184	108,775	100,851	114	619,547	541,282	463,056
Grand Total	118	212,238	180,437	161,633	101	5,136,474	5,076,238	4,756,533

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FERTILIZER MATERIALS MARKET

NEW YORK

Deliveries of Sulphate of Ammonia Being Made on Allocation. High Cost of Organic Nitrogen and Ceiling on Mixed Fertilizer Prices Create Problem. Castor Pomace Becoming Scarce.

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, September 8, 1942.

Sulphate of Ammonia

Deliveries are now being made regularly against allocations for this material. Naturally, with the curtailment to fertilizer manufacturers of inorganic ammonia in its various forms, these manufacturers are looking around in an effort to find organic materials for the replacement of the nitrogen in their mixed fertilizers.

However, with the cost of inorganic ammonia at about $1.00 per unit and the cost of all organic meals much higher, fertilizer manufacturers are very much on the spot with ceiling prices on mixed fertilizers.

Probably this matter will be worked out in due time but in the meantime, it is making the situation quite difficult.

Nitrogenous

All the various grades have been in big demand and the market is about sold up, from all indications.

Nitrate of Soda

Price for Chilean nitrate of soda for September remains the same as during the previous month, and in this material, also, deliveries are being made against allocation.

Potash

Deliveries are being made regularly against contract but here again the market is about sold up and many buyers are looking for additional material.

Castor Pomace

Due to the curtailment of the import of castor beans, principally due to lack of bottoms, supplies of pomace are becoming very scarce.

BALTIMORE

September Nitrate of Soda Prices Unchanged. Fish Scrap Production below Expectations. Paper Bags Coming into Greater Use.

Exclusive Correspondence to "The American Fertilizer"

BALTIMORE, September 8, 1942.

Business in fertilizer materials during the past two weeks has been more or less of routine character.

Organic Ammoniates.—Due to good demand for feeding purposes, the market on tankage and blood continues firm at ceiling prices, with result that practically the entire production is going into the manufacture of feed materials. The nominal market is $6.00 per unit of nitrogen on both tankage and blood, f. o. b. shipping point, which precludes their use in mixed fertilizer at prevailing price of mixed goods.

Nitrogenous Material.—Due to scarcity of raw material there are no offerings of this material on the market. Oil and vegetable meals are also pegged at prices which offer no inducement to fertilizer manufacturers' extensive use of these ingredients.

Sulphate of Ammonia.—The output has been allocated and practically none of the manufacturers has been able to secure normal requirements, but such tonnage as is being allocated is being taken and stored for future use.

Nitrate of Soda.—The market on both imported and domestic nitrate has been extended unchanged for the month of September, being $30.00 per ton in bulk for the Chilean product, ex warehouse, and $33.00 in 100 lb. bags, per ton of 2,000 lb., ex warehouses at ports. Deliveries continue to be allocated by OPA.

Fish Scrap.—With only a few fish companies operating and the catch continuing light, there is some question as to whether

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Birmingham, Ala.	Houston, Texas	San Juan, P. R.
Chicago Heights, Ill.	Jacksonville, Fla.	Sandusky, Ohio
Cincinnati, Ohio	Montgomery, Ala.	Wilmington, N. C.
Columbia, S. C.	Nashville, Tenn.	

current contracts will be completed. In the meanwhile, there are no offerings pressing on the market.

Superphosphate.—No heavy stocks are accumulating and manufacturers continue to quote ceiling prices of $9.60 per ton of 2,000 lb., basis 16 per cent, for run-of-pile, and $10.10 for flat 16 per cent grade, both in bulk, f. o. b. producers' works, Baltimore.

Bone Meal.—Offerings and demand for both raw and steamed bone meal is practically nil.

Potash.—It is reported that practically all producers are now slowing up in making deliveries against contracts previously booked.

Bags.—With an acute shortage of burlap and no immediate arrivals en route, burlap bags are practically unobtainable for fertilizer. Some manufacturers are using cotton bags in a limited way, but the bulk of them are now utilizing paper bags for the shipment of their products.

CHARLESTON

Materials Scarce and Few Offerings in Market. Soy Bean Prices Pending

Exclusive Correspondence to "The American Fertilizer"

CHARLESTON, September 8, 1942.

The soy meal producers are still not quoting for fall shipment, pending agreement with the Government on prices. Sulphate of ammonia continues hard to obtain.

Nitrogenous.—Sellers of this material are still remaining out of the market, and it is reported that one of the largest producers has just had a fire destroying completely their largest factory.

Blood.—This market is completely monopolized by the feed buyers and they are not able to get all they want. Last prices: $5.75 per unit of ammonia ($6.99 per unit N) f. o. b. Chicago.

Cottonseed Meal.—Prices on the 8 per cent grade are as follows: $36.00, Atlanta; $35.50, Memphis.

CHICAGO

Demand for Fertilizer Organics Active but Sales Slow. Feed Market Shows Good Consuming Demand.

Exclusive Correspondence to "The American Fertilizer"

CHICAGO, September 7, 1942.

Demand for organics remains quite active, but sales are rather slow, as sellers are releasing only occasional lots. The nitrogen situation may have some bearing in trading in bone meal which has improved recently.

Only scattered movement can be noted in feed material; volume offering is still lacking. Consuming demand of the finished feeds continues at ceiling prices.

Nominal prices are as follows: high grade ground fertilizer tankage, $3.85 to $4.00 ($4.68 to $4.86 per unit N) and 10 cents; standard grades crushed feeding tankage $5.37 per unit ammonia ($6.53 per unit N); Blood, $5.75 to $5.80 ($6.99 to $7.05 per unit N); dry rendered tankage, $1.21 per unit of protein, Chicago basis.

TENNESSEE PHOSPHATE

Phosphate Shipments Continue at High Levels. Monsanto and Victor Plants Awarded Army-Navy "E" Pennants.

Exclusive Correspondence to "The American Fertilizer"

COLUMBIA, TENN., September 9, 1942.

Shipments of phosphate rock of all grades to various consuming channels are under way at a rapid rate. With the splendid weather prevailing, the entire region is busy in every line of work. The fertilizer department of TVA has completed their new office building at their plant at Godwin and Herbert Mosely has moved his staff from their old quarters in Columbia to the new location.

On September 1st there took place at Mt. Pleasant the second of two outstanding events in Tennessee phosphate circles, the Army-Navy Production Awards to the two great electric furnace plants producing ele-

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mental phosphorus for war use. The Navy "E" pennant had previously been awarded to the Monsanto Chemical Company and the joint Army-Navy award to that company was made privately during the last week in August.

On September 1st the Army-Navy "E" was awarded to the Victor Chemical Works at a ceremony at the Mt. Pleasant plant attended by more than 400 workers with their wives and guests. Brig. Gen. Haig Shekerjian, of the Edgewood Arsenal, made the presentation in a splendid patriotic speech. The award was accepted by August Kochs, president of the Company, in an equally patriotic pledge of all the services of his entire Company. The Mt. Pleasant plant, the largest producers of phosphorus in the world, is now operating at 117 per cent of rated capacity; during the present year it has never fallen below 108 per cent.

The Army-Navy "E" lapel insignia for every worker and official of the plant was presented by Lt. E. E. Keith, U. S. N. R., and was received by one of the workers, Darnell Thurman, on behalf of his colleagues. Porter G. Odom, another employee, speaking on behalf of plant labor, made a speech which reflected great credit on him as a home product of Mt. Pleasant.

Before the ceremonies, the Victor local management were hosts to about one hundred at a luncheon, which gave Mr. Kochs an opportunity to greet his many friends in this vicinity.

An interesting commentary on the ceremony was the fact that on the highway in front of the plant was the spot in a roadside ditch where Judge Weatherly, in April, 1896, picked up what he thought might be a piece of zinc ore but which proved to be the now celebrated Tennessee brown phosphate rock, whose existence made possible the present magnificent plant.

I. M. C. Makes Traffic Appointments

Louis Ware, president of International Minerals and Chemical Corporation has announced the appointment of Roy C. Russell as traffic manager and of Sinclair B. McCoy as assistant traffic manager, both located in the general offices of the Company at Chicago.

APPROVED FERTILIZER GRADES

(Continued from page 9)

Missouri

0—10—20	0—16— 8	3—18— 9
0—12—12	0—20—10	4—10— 6
0—12—24	0—20—20	4—12— 4
0—14— 7	2—12— 6	4—16— 4
0—14—14	3— 9—18	4—24—12
	3—12—12	10— 6— 4

Iowa

0— 9—27	0—20—10	3—18— 9
0—12—12	0—20—20	4—10— 6
0—12—36	2—12— 6	4—12— 4
0—14— 7	3— 9—18	4—16— 4
0—14—14	3—12—12	4—24—12
0—16— 8		10— 6— 4

Michigan

0— 9—27	0—16— 8	3—12—12
0—10—20	0—20—10	3—18— 9
0—12—12	0—20—20	4—10— 6
0—12—24	2— 8—16	4—12— 4
0—12—36	2—12— 6	4—16— 4
0—14— 7	2—16— 8	4—24—12
0—14—14	3— 9—18	10— 6— 4

Wisconsin

0— 9—27	0—16— 8	3—12—12
0—12—12	0—20—10	3—18— 9
0—12—36	0—20—20	4—10— 6
0—14— 7	2—12— 6	4—12— 4
0—14—14	3— 9—18	4—24—12
		10— 6— 4

Minnesota

0— 9—27	0—14—14	3— 9—18
0—10—20	0—16— 8	3—12—12
0—12—12	0—20—10	3—18— 9
0—12—24	0—20—20	4—10— 6
0—12—36	2—12— 6	4—12— 4
0—14— 7	2—16— 8	4—24—12
		10— 6— 4

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THE AMERICAN CHEMICAL SOCIETY

(Continued from page 11)

increased production of foods—for Americans and for the peoples of the United Nations and ultimately of the liberated nations, feeds and forage for livestock, vegetable oils, legumes as a source of agricultural nitrogen as a badly needed supplement to restricted supplies, and a long list of potassium compounds for chemical and other industries producing commodities essential for military and civilian use. For all of these requirements, the potash supplies currently being provided are adequate, representing a war-time contribution of vital importance to the Nation.

The Effects of Lime and Magnesium on Absorption of Potassium by Soil and Plant

Richard Bradfield and Michael Peech, Cornell University

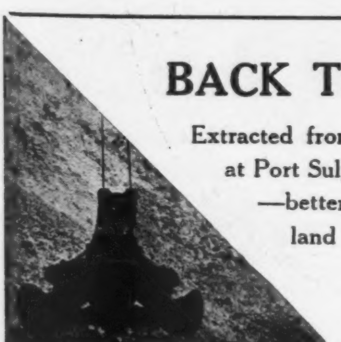
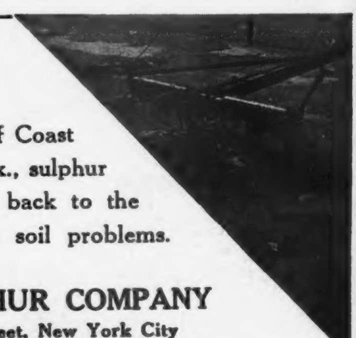
Addition of lime or magnesia frequently suppresses the absorption of potassium by the plant and thus aggravates potassium deficiency in soils with limited supply of this element. This decrease in the assimilation of potassium observed on limed or calcareous soils has been attributed to "ion antagonism" (more properly termed "mutual ion replacement" and "ion competition") as well as to lime-induced fixation of the soil potassium into more insoluble forms. There is considerable evidence that in some soils at least lime facilitates fixation of potassium into nonexchangeable forms. The equilibrium between the exchangeable potassium and that in the soil solution is also influenced by the addition of lime and magnesia. Lime and magnesia applied to the soil may favor the adsorption of potassium from its neutral salts, or may release the adsorbed potassium, depending upon the relative increases in the amounts of the adsorbed Ca or Mg and Ca^{++} or Mg^{++} ion concentration of the soil solution. Increases in the degree of Ca or Mg saturation favor the adsorption of K from its neutral salts, whereas increases in the Ca^{++} or Mg^{++} ion concentration in the soil solution liberate the adsorbed K. The inverse Ca-K or Mg-K relationship frequently observed within the plant is, in many instances, primarily a physiological phenomenon ("mutual ion replacement" in the plant), rather than a direct result of Ca-K or Mg-K soil interreactions which might render the native or added K more insoluble.

Nitrogen, Phosphorus, and Potassium Interrelationships in Young Peach and Apple Trees

F. P. Cullinan and L. P. Batjer, U. S. Bureau of Plant Industry, Washington, D. C.

When peach trees grown in soils with low available potassium are supplied with adequate nitrogen, characteristic symptoms of potassium deficiency appear on the leaves. Such leaves upon analysis will show a potassium content of less than 1 per cent on a dry-weight basis.

With 1-year-old peach trees in sand culture, where N, P, and K were supplied at low, intermediate, and adequate levels to study the interaction of these ions, the most outstanding differences in growth at the various levels were due to nitrogen, irrespective of the amounts of other nutrients supplied. An increase in the nitrogen level resulted in significantly increased growth even with phosphorus and potassium at their lowest levels, and this increase became greater at the higher levels of phosphorus and potassium. When potassium was maintained at a low level (3 p.p.m.) and nitrogen at intermediate (50 p.p.m.) and high levels (85 p.p.m.) characteristic potassium deficiency symptoms were observed. Nitrogen, phosphorus, and potassium content of the leaves on the basis of dry weights reflected very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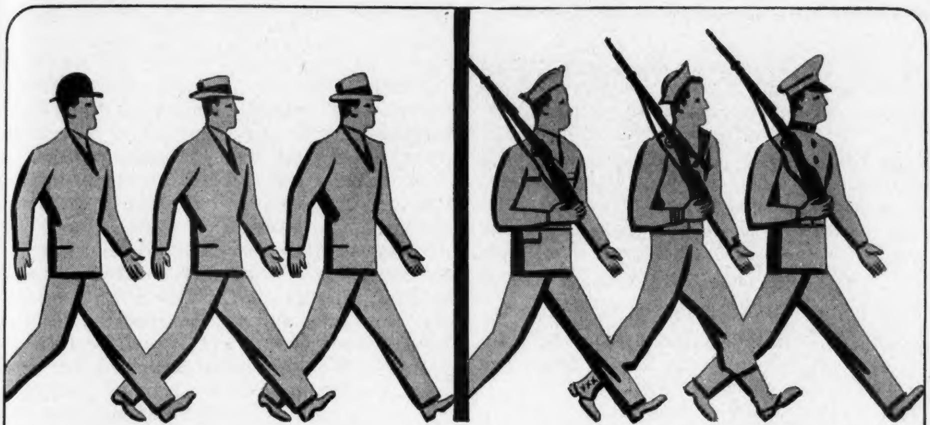

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consistently the observations on foliar appearance.

Varying concentrations of potassium and phosphorus in the nutrient solution has no significant effect on growth of young apple trees at the low nitrogen level (10 p.p.m.) but at the medium (25 p.p.m.) and high (100 p.p.m.) nitrogen levels, growth increased with increasing supplies of these elements. In contrast to response of peach, no visible potassium or phosphorus deficiency symptoms were observed in the leaves at any concentration.

A Short Method for the Determination of Potash in Fertilizers or Base Goods in the Absence of Ammonium Salts and Organic Matter

Philip McG. Shuey, Savannah, Ga.

A method has been developed in which the potash may be very accurately determined in the same simple manner as when making the determination in potash salts according to the Official A. O. A. C. method. Instead of removing lime as the oxalate, it is precipitated, after boiling the prescribed period, by the addition of sodium phosphate and sodium hydroxide in slight excess. A little soluble phosphate is previously added by reason of the fact that calcium is always present in superphosphate in excess of that required to form calcium phosphate. This is because calcium is also combined with fluorine and as carbonate in the original phosphate rock.

The removal of calcium as phosphate when properly done is about as complete as its removal as oxalate, but the presence of a small amount of calcium in solution does not interfere with accuracy.

The method has the advantage over the official method in that only one evaporation is required, and no ignition with its accompanying possible loss, is necessary.

The sodium chloride formed does not cause results to be too high. An experiment was made by adding sodium chloride to potassium chloride and results were extremely close to theory even when using 95 per cent Specially Denatured alcohol, Formula No. 30.

Phosphatic Fertilizer and Iron from Ferrophosphorus

G. L. Bridger and R. M. Neel, Tennessee Valley Authority, Wilson Dam, Ala.

Ferrophosphorus is a by-product of the reduction of rock phosphate by the electric-furnace method. A process has been developed for the conversion of ferrophosphorus into a phosphatic slag useful as a fertilizer, and iron of high purity. The process consists of (1) heating a mixture of finely ground ferrophosphorus and finely ground limestone in a rotary kiln to obtain partial oxidation of the ferrophosphorus and complete calcination of the limestone, and (2) melting the resultant kiln product in an electric furnace to obtain phosphatic slag and iron. When ferrophosphorus containing 20 per cent of phosphorus and 8 per cent of silicon was used, the phosphatic slag contained about 22 per cent P_2O_5, of which 95 per cent was soluble in citrated ammonium nitrate solution, and the iron contained 0.02 per cent of phosphorus and other impurities in similar proportions. The conditions required for operation of the process were determined in small-scale experiments, and checked on a pilot-plant scale. Plant-growth tests with two soils indicated that the phosphatic slag was the equal of concentrated superphosphate as a source of phosphorus for plants.

AN EASIER, MORE EFFECTIVE METHOD OF APPLYING FERTILIZERS

(Continued from page 7)

and ammonium nitrate; second, the ammonia form, such as ammonium sulphate fertilizer, the most commonly used nitrogen in mixed goods; and third, the organic form, such as urea, dried blood, sewage sludge, etc. Each type behaves differently in the soil.

Nitrate nitrogen is the most mobile form. It dissolves readily in the soil water and moves freely. During periods of rainfall it percolates downward and when moisture is evaporating at the surface it moves upward in the capillary rise of water. Unless absorbed by plant roots it may be carried to the surface where it is deposited as a salt crust as the water evaporates. At the next rain it dissolves and moves downward again. In periods

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Information and references available on request.

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See Page 4

of excessive rainfall it may be leached out of a light soil.

Ammonia nitrogen and urea and cyanamid are less mobile in the soil than nitrate nitrogen. Ammonia nitrogen dissolves readily in the soil water and starts to move about, but in a soil containing colloidal material, such as clay or organic matter, it reacts with the base exchange material and becomes fixed in an exchangeable form that is readily available to plants. If placed deeply in the soil most of the ammonia nitrogen will remain there in the root zone. Through the action of nitrifying bacteria some of the ammonia nitrogen gradually becomes converted to the nitrate form which is then very mobile in the soil.

Through bacterial decomposition, organic nitrogen fertilizers, such as tankage and cottonseed meal, produce free ammonia in the soil and behave in a similar way as the ammonia-type fertilizers.

Fig. 3—Attachment on tractor to apply fertilizer while plowing.

Phosphorus fertilizers are at the opposite extreme from nitrates in mobility in the soil. In most soils phosphorus is quickly fixed in an insoluble form and remains where it is applied. If applied on the surface, it will remain fixed there. On very acid soils the phosphorus rapidly combines with iron or aluminum to form insoluble phosphates which are not available to plants. On alkaline soils the phosphorus combines with calcium to form the insoluble tricalcium phosphate. Applying phosphorus fertilizers in concentrated bands will retard the rate of fixation and maintain the phosphorus in an available condition for a longer period because less surface is exposed to the mass action of the soil. Mixing phosphorus fertilizer through the soil hastens its fixation and therefore reduces its availability to plants.

Potash is somewhat intermediate between nitrate nitrogen and phosphorus in its mobility in the soil. In a sand having little or no clay or organic matter the potash will move freely in the movement of the soil water, and is often leached out. In soils containing clay or well-decomposed organic matter, the potash will react with the colloidal material and become fixed in place in an exchangeable form. In many soils a portion of the exchangeable potash changes over in time to a non-exchangeable form. This fixation process is greatly hastened by alternate wetting and drying. To reduce the rate of fixation the potash should be applied deeply enough to avoid the rapid wetting and drying that occurs in the surface 2 or 3 inches of soil.

It is apparent, therefore, that plowing under fertilizer places it in the zone of active root growth, and particularly if the fertilizer is applied in a band in the bottom of the furrow, it will remain in a form that is available to the plant for a longer period. Furthermore, when drought periods occur in midsummer and when the plant is making the greatest draft on the soil for nutrients, this fertilizer will be in the most accessible form.

Three Types of Attachments

Three types of attachments to plows that will apply fertilizer either in bands in the bottom of the furrow or ahead of the plow so that it can be turned under are shown in the illustrations. Fig. 1 shows an attachment to a two-bottom plow. In this attachment the distributing mechanism is driven by the plow wheel which rides in the bottom of the furrow. This mechanism was devised by a very large grower in New Jersey and has been used very successfully by him for three years.

Another type of attachment for a two-bottom plow is shown in Fig. 2. In this attachment the distributing mechanism is

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driven by a wheel on the land side of the plow. This machine was put out by a commercial farm equipment company for trial during the past season, and will probably be in commercial production for next year. The rate of application can be regulated by a gate in the hopper and also by sprockets in the driving mechanism if it is desired to apply very large quantities. This fertilizer distributor can be attached to a plow in 15 minutes. The fertilizer delivery tubes can be clamped in the rear of the plow to deposit the fertilizer in bands in the bottom of the furrow, as shown in the illustrations, or they can be clamped in front of the plow and apply the fertilizer on the surface just before the

Fig. 4—Fertilizer deposited in bottom of furrow is very effectively used by crops. This attachment saves labor in applying fertilizer and increases yields.

furrow is turned under, thus distributing it from the top to the bottom of the furrow.

A third type of distributor is shown in Fig. 3, which is an attachment for a two-way plow. In this case the distributing mechanism is driven by a bevel gear and shaft through the spindle bolt of the front wheel of the tractor. By means of different sized sprockets, the rate of application can be very accurately adjusted. This mechanism was devised by engineers of the Bureau of Agricultural Chemistry and Engineering of the U. S. Department of Agriculture.

During the present season field tests of the effectiveness of plowing under fertilizer can be observed in several regions of the State and on different soil types. On the Canning Crops Farm at the Experiment Station at Geneva there are very extensive and well-replicated experiments with tomatoes, cabbage, and sweet corn in which fertilizers have been (a) broadcast and plowed under, (b) plowed under with an attachment to the plow that deposits the fertilizer in a band in the bottom of the furrow, (c) broadcast and disced in, (d) drilled deeply with a fertilizer drill, and (e) applied in bands close to the row.

A similar series with tomatoes only can be seen at the Station's Vineyard Laboratory at Fredonia. At Geneva the tests are on Ontario loam soil, and for each crop a rye cover crop 22 inches high was turned under with the fertilizers. At Fredonia the soil is Fulton silty clay loam and is poorly drained, which may not be favorable for the plowed under fertilizer.

In another test with tomatoes on the farm of C. L. Ford near Bergen, he applied to a portion of his field 600 pounds of 4–12–4 fertilizer using the attachment shown in Fig. 2 which deposited the fertilizer in a band in the bottom of the furrow which was 9½ inches deep. The remainder of the field received the same amount of fertilizer applied broadcast and plowed under. This soil is Honeoye silt loam.

On a similar soil near South Byron, Mr. George Miller used this attachment to apply about 1,400 pounds of fertilizer for tomatoes. Near Hall, N. Y., on the Robson Bros. Seed Farm, this attachment was used to apply 300 pounds of fertilizer for sweet corn. The results of these tests will be watched with great interest.

In conclusion, the advantages of plowing under fertilizer especially with an attachment to the plow that deposits the fertilizer in the bottom of the furrow are: First, labor is saved because the fertilizer can be applied while plowing, thus saving one operation. Second, the fertilizer is placed where it is more accessible to the roots and where it is less rapidly fixed in the soil so that it can be used more effectively by the crop, thus increasing yields. Third, it avoids danger of injury to the crop from fertilizer "burning" due to excessive concentrations of soluble salts. This factor of safety is very important, particularly with sensitive crops such as beans, peas, beets, etc. Fourth, when fertilizer is applied with the plow, the job is completed before the rush of work at planting time. Fifth, the deeply placed fertilizer will enable plants to continue to grow during drought periods.

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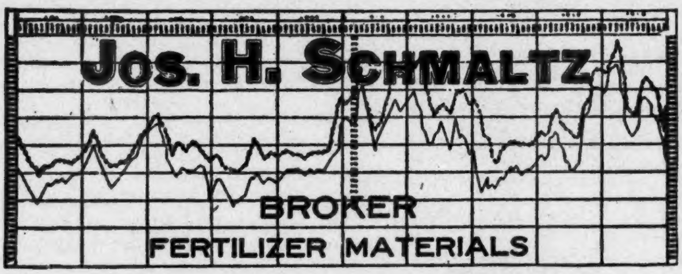

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Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

CRANES AND DERRICKS
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

CYANAMID
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Jett, Joseph C., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

DENS—Superphosphate
Chemical Construction Corp., New York City.
Stedman's Foundry and Mach. Works, Aurora, Ind.

Andrew M. Fairlie
CHEMICAL ENGINEER
22 Marietta Street Building ATLANTA, GA.
CABLE ADDRESS: "SULFACID ATLANTA"

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Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DRYERS—Direct Heat
Sackett & Sons Co., The A. J., Baltimore, Md.

DRIVES—Electric
Link-Belt Company, Philadelphia, Chicago.

DUMP CARS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DUST COLLECTING SYSTEMS
Sackett & Sons Co., The A. J., Baltimore, Md.

ELECTRIC MOTORS AND APPLIANCES
Atlanta Utility Works, East Point, Ga.
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ELEVATORS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ELEVATORS AND CONVEYORS—Portable
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

ENGINEERS—Chemical and Industrial
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Fairlie, Andrew M., Atlanta, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ENGINES—Steam
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

EXCAVATORS AND DREDGES—Drag Line and Cableway
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link Belt Speeder Corp., Chicago, Ill., and Cedar Rapids, Iowa.

FERTILIZER MANUFACTURERS
American Agricultural Chemical Co., New York City.
American Cyanamid Company, New York City.
Armour Fertilizer Works, Atlanta, Ga.
Farmers Fertilizer Company, Columbus, Ohio.
International Minerals and Chemical Corporation, Chicago, Ill.
Phosphate Mining Co., The, New York City.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Wellmann, William E., Baltimore, Md.

FOUNDERS AND MACHINISTS
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GARBAGE TANKAGE
Wellmann, William E., Baltimore, Md.

GEARS—Machine Moulded and Cut
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GEARS—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

GELATINE AND GLUE
American Agricultural Chemical Co., New York City.

GUANO
Baker & Bro., H. J., New York City.

HOISTS—Electric, Floor and Cage Operated, Portable
Hayward Company, The, New York City.

HOPPERS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

IMPORTERS, EXPORTERS
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

IRON SULPHATE
Tennessee Corporation, Atlanta, Ga.

INSECTICIDES
American Agricultural Chemical Co., New York City.

LACING—Belt
Sackett & Sons Co., The A. J., Baltimore, Md.

LIMESTONE
American Agricultural Chemical Co., New York City.
American Limestone Co., Knoxville, Tenn.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
McIver & Son, Alex. M., Charleston, S. C.
Wellmann, William E., Baltimore, Md.

LOADERS—Car and Wagon, for Fertilizers
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Duriron Co., Inc., The, Dayton, Ohio.
Fairlie, Andrew M., Atlanta, Ga.
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Coal and Ash Handling
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Elevating and Conveying
Atlanta Utility Works, East Point, Ga.
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Grinding and Pulverizing
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

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MACHINERY—Tankage and Fish Scrap
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MAGNETS
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Sackett & Sons Co., The A. J., Baltimore, Md.
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MANGANESE SULPHATE
McIver & Son, Alex. M., Charleston, S. C.
Tennessee Corporation, Atlanta, Ga.

MIXERS
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Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

NITRATE OF SODA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Division, The, Allied Chemical & Dye Corp., New York City.
Bradley & Baker, New York City.
Chilean Nitrate Sales Corp., New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

NITRATE OVENS AND APPARATUS
Chemical Construction Corp., New York City.

NITROGEN SOLUTIONS
Barrett Division, The, Allied Chemical & Dye Corp., New York City.

NITROGENOUS ORGANIC MATERIAL
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
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Huber & Company, New York City.
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NOZZLES—Spray
Monarch Mfg. Works, Philadelphia, Pa.

PACKING—For Acid Towers
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

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Bradley & Baker, New York City.
Huber & Company, New York City.
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McIver & Son, Alex. M., Charleston, S. C.
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Schmaltz, Jos. H., Chicago, Ill.
Southern Phosphate Corp., Baltimore, Md.
Virginia-Carolina Chemical Corp. (Mining Dept.), Richmond, Va.
Wellmann, William E., Baltimore, Md.

PIPE—Acid Resisting
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PIPES—Chemical Stoneware
Chemical Construction Corp., New York City.

PIPES—Wooden
Stedman's Foundry and Mach. Works, Aurora, Ind.

PLANT CONSTRUCTION—Fertilizer and Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

POTASH SALTS—Manufacturers
American Potash and Chem. Corp., New York City.
Potash Co. of America, New York City.
International Minerals & Chemical Corp., Chicago, Ill.
United States Potash Co., New York City.

PULLEYS AND HANGERS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

PUMPS—Acid-Resisting
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Duriron Co., Inc., The, Dayton, Ohio.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., New York City.
Wellmann, William E., Baltimore, Md.

QUARTZ
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

RINGS—Sulphuric Acid Tower
Chemical Construction Corp., New York City.

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Bradley & Baker, New York City.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

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Hayward Company, The, New York City.

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Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
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SEPARATORS—Air
Sackett & Sons Co., The A. J., Baltimore, Md.

SEPARATORS—Including Vibrating
Sackett & Sons Co., The A. J., Baltimore, Md.

SEPARATORS—Magnetic
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHAFTING
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHOVELS—Power
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corporation, Chicago, Ill., and Cedar Rapids, Iowa.
Sackett & Sons Co., The A. J., Baltimore, Md.

SPRAYS—Acid Chambers
Monarch Mfg. Works, Inc., Philadelphia, Pa.

SPROCKET WHEELS (See Chains and Sprockets)

STACKS
Sackett & Sons Co., The A. J., Baltimore, Md.

SULPHATE OF AMMONIA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Division, The, Allied Chemical & Dye Corp., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Hydrocarbon Products Co., New York City.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
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Wellmann, William E., Baltimore, Md.

SULPHUR
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Freeport Sulphur Co., New York City.
Texas Gulf Sulphur Co., New York City.

SULPHURIC ACID
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Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.

SULPHURIC ACID—Continued
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
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Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE—Concentrated
Armour Fertilizer Works, Atlanta, Ga.
International Minerals & Chemical Corporation, Chicago, Ill.
Phosphate Mining Co., The, New York City.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.

SYPHONS—For Acid
Monarch Mfg. Works, Inc., Philadelphia, Pa.

TALLOW AND GREASE
American Agricultural Chemical Co., New York City.

TANKAGE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Smith-Rowland, Norfolk, Va.
Wellmann, William E., Baltimore, Md.

TANKAGE—Garbage
Huber & Company, New York City.

TANKS
Sackett & Sons, Co., The A. J., Baltimore, Md.

TILE—Acid-Proof
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

TOWERS—Acid and Absorption
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

UNLOADERS—Car and Boat
Hayward Company, The, New York City.
Sackett & Sons Co., The A. J., Baltimore, Md.

UREA
DuPont de Nemours & Co., E. I., Wilmington, Del.

UREA-AMMONIA LIQUOR
DuPont de Nemours & Co., E. I., Wilmington, Del.

VALVES—Acid-Resisting
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Duriron Co., Inc., The, Dayton, Ohio.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

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ZINC SULPHATE
Tennessee Corporation, Atlanta, Ga.

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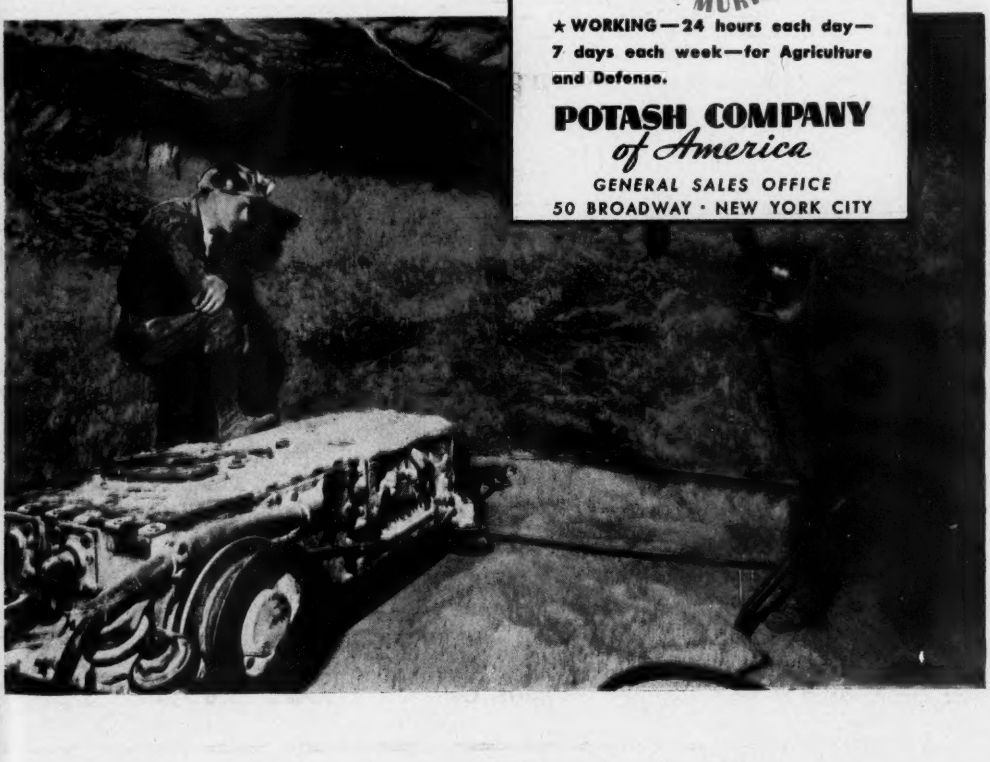

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